Section 3

Winds

Objectives

After this lesson, students will be able to

I.2.3.1 State how scientists describe and explain winds.

I.2.3.2 Distinguish between local winds and global winds.

I.2.3.3 Identify where the major global wind belts are located.

Target Reading Skill

Relating Cause and Effect Explain that cause is the reason for what happens. The effect is what happens as a result of the cause. Relating cause and effect helps students relate the reason for what happens with the result.

Answers

Possible answers for Effects:
Warm air expands, becomes less dense, and rises.
Cold, more dense air sinks.
Dense, cold air has a higher pressure than less dense warm air. Wind blows from areas of higher pressure to areas of lower pressure.

All in One Teaching Resources

- Transparency I15

Preteach

L1

Build Background Knowledge

Flying Kites

Ask students to recall times when they have flown kites. Ask: **What made the kite fly in the air?** *(Wind)* **What is wind?** *(The movement of air)* Remind students how hard it can be to hold on to a kite against the force of a strong wind. Stress that, even though air is an invisible gas, it still consists of molecules, and the movement of these molecules, especially at high speeds, can exert great force.

Section 3

Winds

Reading Preview

Key Concepts

- What causes winds?
- How do local winds and global winds differ?
- Where are the major global wind belts located?

Key Terms

- wind
- anemometer
- wind-chill factor
- local winds
- sea breeze
- land breeze
- global winds
- Coriolis effect
- latitude
- jet stream

Target Reading Skill

Relating Cause and Effect As you read, identify how the unequal heating of the atmosphere causes the air to move. Write the information in a graphic organizer like the one below.

Cause: Unequal heating of the atmosphere → Effects: Warm air expands, becomes less dense, and rises. / [blank] / [blank]

Lab zone Discover Activity

Does the Wind Turn?

Do this activity with a partner. Let the ball represent a model of Earth and the marker represent wind.

1. Using heavy-duty tape, attach a pencil to a large smooth ball so that you can spin the ball from the top without touching it.
2. One partner should hold the pencil. Slowly turn the ball counterclockwise when seen from above.
3. While the ball is turning, the second partner should use a marker to try to draw a straight line from the "North Pole" to the "equator" of the ball. What shape does the line form?

Think It Over

Making Models If cold air were moving south from Canada into the continental United States, how would its movement be affected by Earth's rotation?

Have you ever flown a kite? Start by unwinding a few meters of string with the kite downwind from you. Have a friend hold the kite high overhead. Then, as your friend releases the kite, run directly into the wind. If you're lucky, the kite will start to rise. Once the kite is stable, you can unwind your string to let the wind lift the kite high into the sky. But what exactly is the wind that lifts the kite, and what causes it to blow?

A kite festival in Capetown, South Africa ▶

Lab zone Discover Activity

Skills Focus Making models L1

Materials heavy-duty tape, pencil, large smooth ball, marker

Time 10 minutes

Tips Make sure that each student spins the ball counterclockwise before his or her partner draws on it. Students might also draw a line from the "South Pole" to the "Equator" to see in which direction winds blow in the Southern Hemisphere.

Expected Outcome Students' lines should veer west from the "North Pole" to the "Equator."

Think It Over The movement of air from Canada would turn west.

What Is Wind?

Because air is a fluid, it can move easily from place to place. Differences in air pressure cause the air to move. A **wind** is the horizontal movement of air from an area of high pressure to an area of lower pressure. **Winds are caused by differences in air pressure.**

Most differences in air pressure are caused by the unequal heating of the atmosphere. Convection currents form when an area of Earth's surface is heated by the sun's rays. Air over the heated surface expands and becomes less dense. As the air becomes less dense, its air pressure decreases. If a nearby area is not heated as much, the air above the less-heated area will be cooler and denser. The cool, dense air with a higher pressure flows underneath the warm, less dense air. This forces the warm air to rise.

Measuring Wind Winds are described by their direction and speed. Wind direction is determined with a wind vane. The wind swings the wind vane so that one end points into the wind. The name of a wind tells you where the wind is coming from. For example, a south wind blows from the south toward the north. A north wind blows to the south.

Wind speed can be measured with an **anemometer** (an uh MAHM uh tur). An anemometer has three or four cups mounted at the ends of spokes that spin on an axle. The force of the wind against the cups turns the axle. A meter on the axle shows the wind speed.

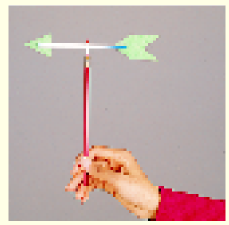
Wind-Chill Factor On a warm day, a cool breeze can be refreshing. But during the winter, the same breeze can make you feel uncomfortably cold. The wind blowing over your skin removes body heat. The stronger the wind, the colder you feel. The increased cooling a wind can cause is called the **wind-chill factor.** Thus a weather report may say, "The temperature outside is 20 degrees Fahrenheit. But with a wind speed of 30 miles per hour, the wind-chill factor makes it feel like 1 degree above zero."

Reading Checkpoint Toward what direction does a west wind blow?

Lab zone Try This Activity

Build a Wind Vane

1. Use scissors to cut out a pointer and a slightly larger tail fin from construction paper.
2. Make a slit 1 cm deep in each end of a soda straw.
3. Slide the pointer and tail fin into place on the straw, securing them with small pieces of tape.



4. Hold the straw on your finger to find the point at which it balances.
5. Carefully push a pin through the balance point and into the eraser of a pencil. Make sure the wind vane can spin freely.

Observing How can you use your wind vane to tell the direction of the wind?

FIGURE 6
Wind Direction and Speed
The wind vane on the left points in the direction the wind is blowing from. The anemometer on the right measures wind speed. The cups catch the wind, turning faster when the wind blows faster.

Instruct

What Is Wind?

Teach Key Concepts L2

Explain and Describe Winds

Focus Review with students that differences in temperature cause differences in density.

Teach Ask: **What happens to the density of air when it is heated?** *(It decreases.)* **How does this affect air pressure?** *(It also decreases.)* Explain that unequal heating in the troposphere leads to differences in air pressure and causes wind. Meteorologists, or weather scientists, use standard terms when discussing winds. Ask: **What characteristics of wind does a weather report contain?** *(Direction and speed)* **What other factor is sometimes reported during cold weather?** *(The wind-chill factor)* Explain that the wind-chill factor is a measure of how cold people and animals feel when they are outside in cold temperatures.

Apply Tell students that the only effect of wind chill on inanimate objects, such as car radiators and water pipes, is to shorten the amount of time for the object to cool. The inanimate object will not cool below the actual air temperature. **learning modality: logical/mathematical**

Independent Practice L2

All in One Teaching Resources

- Guided Reading and Study Worksheet: *Winds*

Student Edition on Audio CD

Lab zone Try This Activity

Skills Focus observing L1

Materials scissors, construction paper, metric ruler, soda straw, tape, straight pin, pencil with eraser

Time 15 minutes

Tips *Advise students to be careful when using the scissors.*

Expected Outcome Students should find when they take their wind vane outside in the wind or blow on it that the wind vane points in the direction from which the wind is coming.

Extend If students set their wind vane in the center of a compass, it will show them whether it is an east, west, north, or south wind. Remind students that winds are named for the direction from which they blow. **learning modality: kinesthetic**

Monitor Progress L2

Drawing Have students make a simple drawing with arrows and labels to show how differences in air temperature cause wind. Have students place their drawings in their portfolios.

Portfolio

Answer

Reading Checkpoint Toward the east

Local Winds

Teach Key Concepts L1

Sea Breezes and Land Breezes

Focus Refer students to Figure 7.

Teach Explain that sea breezes come from a body of water, and land breezes come from an area of land. Ask: **During what part of a 24-hour day does warm air rise over the land?** *(During the daytime)* **During what part of a 24-hour day does warm air rise over a body of water?** *(During the night)* Explain that land and water absorb and release heat at different rates, resulting in sea breezes during the day and land breezes at night.

Apply Ask students whether they have ever walked between two tall, close buildings. *(Students may point out that the wind is very strong in such areas.)* Explain that on a local scale, wind direction can be affected by such features as hills, trees, and buildings. Even bushes and cars can cause wind to change direction. **learning modality: logical/ mathematical**

Help Students Read L1

Visualizing Refer to the Content Refresher for guidance in using visualizing. As students read each subtitled section on these pages, ask them to close their eyes and imagine how local and global winds are formed. Have them refer to Figures 7, 8, and 11 to help them visualize the various wind formations.

All in One Teaching Resources

- Transparency I16

Local Winds

Have you ever noticed a breeze at the beach on a hot summer day? Even if there is no wind inland, there may be a cool breeze blowing in from the water. This breeze is an example of a local wind. **Local winds** are winds that blow over short distances. **Local winds are caused by the unequal heating of Earth's surface within a small area.** Local winds form only when large-scale winds are weak.

Sea Breeze Unequal heating often occurs along the shore of a large body of water. It takes more energy to warm up a body of water than it does to warm up an equal area of land. As the sun heats Earth's surface during the day, the land warms up faster than the water. As a result, the air over the land becomes warmer than the air over the water. The warm air expands and rises, creating a low-pressure area. Cool air blows inland from over the water and moves underneath the warm air, causing a sea breeze. A **sea breeze** or a lake breeze is a local wind that blows from an ocean or lake. Figure 7 shows a sea breeze.

Land Breeze At night, the process is reversed. Land cools more quickly than water, so the air over the land becomes cooler than the air over the water. As the warmer air over the water expands and rises, cooler air from the land moves beneath it. The flow of air from land to a body of water is called a **land breeze.**

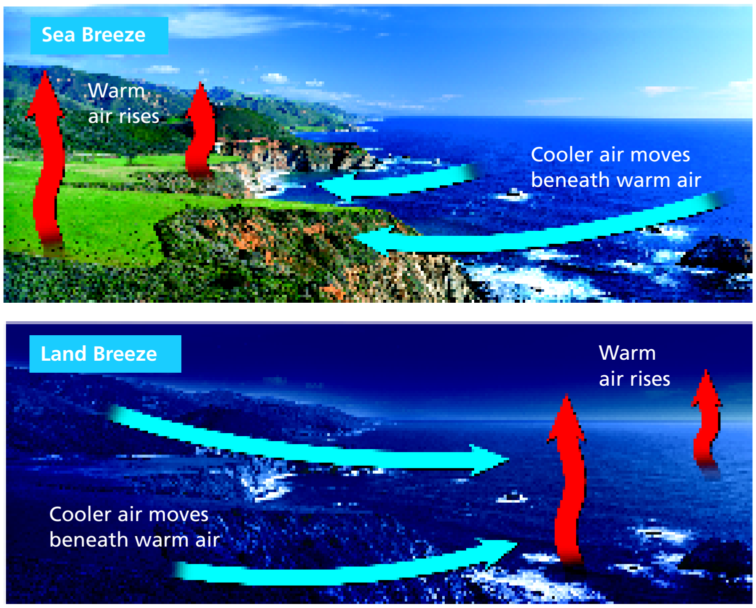


FIGURE 7
Local Winds
During the day, cool air moves from the sea to the land, creating a sea breeze. At night, cooler air moves from the land to the sea.
Forming Operational Definitions *What type of breeze occurs at night?*

Global Winds

Global winds are winds that blow steadily from specific directions over long distances. **Like local winds, global winds are created by the unequal heating of Earth's surface. But unlike local winds, global winds occur over a large area.** Recall how the sun's radiation strikes Earth. In the middle of the day near the equator, the sun is almost directly overhead. The direct rays from the sun heat Earth's surface intensely. Near the poles, the sun's rays strike Earth's surface at a lower angle. The sun's energy is spread out over a larger area, so it heats the surface less. As a result, temperatures near the poles are much lower than they are near the equator.

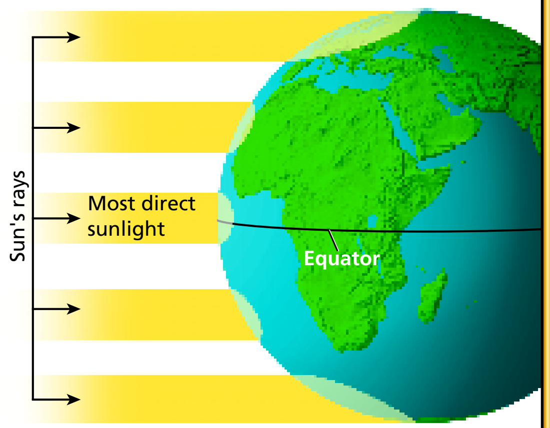


FIGURE 8
Angle of Sun's Rays
Near the equator, energy from the sun strikes Earth almost directly. Near the poles, the same amount of energy is spread out over a larger area.

Global Convection Currents How do global winds develop? Temperature differences between the equator and the poles produce giant convection currents in the atmosphere. Warm air rises at the equator, and cold air sinks at the poles. Therefore air pressure tends to be lower near the equator and greater near the poles. This difference in pressure causes winds at Earth's surface to blow from the poles toward the equator. Higher in the atmosphere, however, air flows away from the equator toward the poles. Those air movements produce global winds.

The Coriolis Effect If Earth did not rotate, global winds would blow in a straight line from the poles toward the equator. Because Earth is rotating, however, global winds do not follow a straight path. As the winds blow, Earth rotates from west to east underneath them, making it seem as if the winds have curved. The way Earth's rotation makes winds curve is called the **Coriolis effect** (kawr ee OH lis).

Because of the Coriolis effect, global winds in the Northern Hemisphere gradually turn toward the right. As Figure 9 shows, a wind blowing toward the south gradually turns toward the southwest. In the Southern Hemisphere, winds curve toward the left.

Reading Checkpoint **Which way do winds turn in the Southern Hemisphere?**

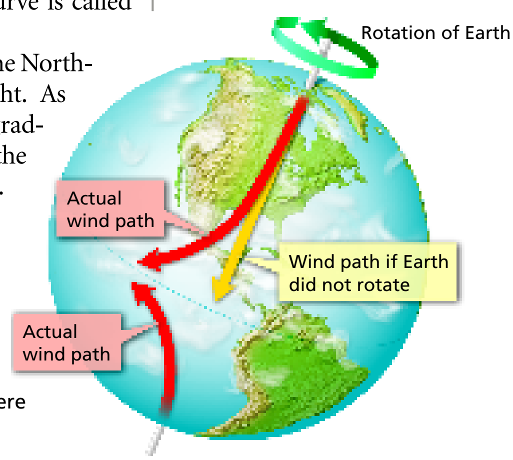


FIGURE 9
Coriolis Effect
As Earth rotates, the Coriolis effect turns winds in the Northern Hemisphere toward the right.

Global Winds

Teach Key Concepts L1

Comparing Local and Global Winds

Focus Remind students that winds are caused by differences in air pressure.

Teach Ask: **How do local winds differ from global winds?** *(Global winds occur over a very large area over Earth; local winds are limited to much smaller areas.)* **How is the formation of global convection currents similar to the way that land and sea breezes are formed?** *(Both are caused by warm air rising and cooler air sinking.)*

Apply Ask: **Why do planes and ships have a special interest in global winds?** *(The speed and direction of global winds can affect the speed of planes and ships and the course they follow.)* **learning modality: logical/ mathematical**

Lab zone Teacher Demo L3

Modeling Global Winds

Materials globe, small flashlight

Time 5 minutes

Focus Remind students that the sun's rays strike directly near the equator.

Teach Dim the lights in the room, and shine the flashlight on the equator. Call attention to the fact that the light is direct and bright over the equator but angled and dim at the poles.

Apply Ask: **How do these differences in energy cause global winds?** *(The more concentrated energy falling directly on the equator causes air over the equator to be warmer and less dense than air over the poles, leading to differences in air pressure that cause global winds to blow from the poles toward the equator.)* **learning modality: visual**

Differentiated Instruction

Less Proficient Readers L1

Outlining the Section Suggest that students outline the section by using its headings and subheadings. As they read, students list the main points under each heading. Pair students with more proficient readers if needed. **learning modality: verbal**

Gifted and Talented L3

Making a Chart Have students use the temperature range of their area in winter to make an annotated version of a wind-chill factor chart (access noaa.gov). Post the chart, and have students get the temperature and wind speed from local weather reports over several days and then determine the wind chill and report it to the class. **learning modality: visual**

Monitor Progress L2

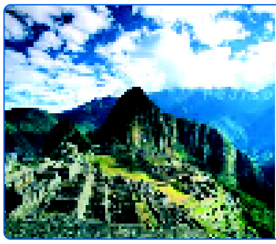
Writing Have students describe how the Coriolis effect influences global winds.

Answers

Figure 7 A land breeze

Reading Checkpoint They curve to the left

Global Wind Belts



Discovery Channel School Video Field Trip

Weather Factors

Show the Video Field Trip to help students understand weather factors. Discussion question: **What is the relationship between air pressure and wind?** *(Differences in air pressure around the globe mean that hot, less dense air rises and cold, more dense air flows downward. This air movement creates winds.)*

Teach Key Concepts L2

Areas of Calm and Wind

Focus Refer students to Figure 11.

Teach Ask: **What do the small blue arrows pointing straight north or straight south represent?** *(Convection currents in the atmosphere)* **The large red arrows?** *(Global winds)* Ask: **Where are areas of calm, and why are these areas calm?** *(The doldrums; air is heated rapidly and rises before it moves very far, so there is little wind. The horse latitudes; air cools and sinks, so there is little difference in air pressure.)* **Why would the ocean where the trade winds blow be a good place to sail?** *(The trade winds are steady winds produced by the movement of cold air from the horse latitudes, and they are warmer than the prevailing westerlies and polar easterlies because they are near the equator.)* Ask students to summarize the characteristics that differentiate the various wind belts. *(The location and how they are formed)*

Apply Ask students to imagine that they are sailing from Seattle, Washington, to the tip of South America. Ask: **Which winds would help speed you on your way?** *(In the Northern Hemisphere, the trade winds; in the Southern Hemisphere, the prevailing westerlies)* **Which would slow you down?** *(In the Northern Hemisphere, the prevailing westerlies; in the Southern Hemisphere, the trade winds)* **learning modality: visual**

Discovery Channel School

Weather Factors

Video Preview
▶ Video Field Trip
Video Assessment

Figure 10
Ocean Sailing
Sailing ships relied on global winds to speed their journeys to various ports around the world.
Applying Concepts *How much effect do you think the prevailing winds have on shipping today?*

Global Wind Belts

The Coriolis effect and other factors combine to produce a pattern of calm areas and wind belts around Earth, as shown in Figure 11. The calm areas include the doldrums and the horse latitudes. **The major global wind belts are the trade winds, the polar easterlies, and the prevailing westerlies.**

Doldrums Near the equator, the sun heats the surface strongly. Warm air rises steadily, creating an area of low pressure. Cool air moves into the area, but is warmed rapidly and rises before it moves very far. There is very little horizontal motion, so the winds near the equator are very weak. Regions near the equator with little or no wind are called the doldrums.

Horse Latitudes Warm air that rises at the equator divides and flows both north and south. **Latitude** is distance from the equator, measured in degrees. At about 30° north and south latitudes, the air stops moving toward the poles and sinks. In each of these regions, another belt of calm air forms. Hundreds of years ago, sailors becalmed in these waters ran out of food and water for their horses and had to throw the horses overboard. Because of this, the latitudes 30° north and south of the equator came to be called the horse latitudes.

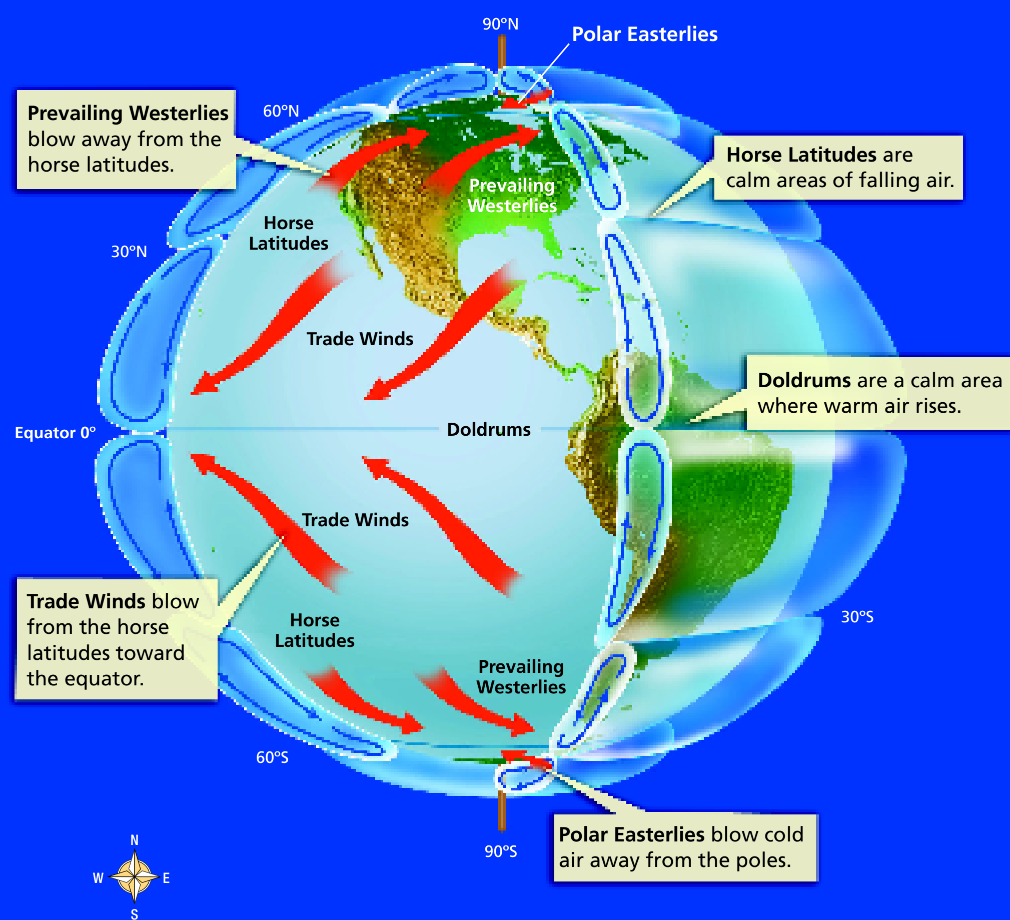
Trade Winds When the cold air over the horse latitudes sinks, it produces a region of high pressure. This high pressure causes surface winds to blow both toward the equator and away from it. The winds that blow toward the equator are turned west by the Coriolis effect. As a result, winds in the Northern Hemisphere between 30° north latitude and the equator generally blow from the northeast. In the Southern Hemisphere between 30° south latitude and the equator, the winds blow from the southeast. For hundreds of years, sailors relied on these winds to move ships carrying valuable cargoes from Europe to the West Indies and South America. As a result, these steady easterly winds are called the trade winds.

Prevailing Westerlies In the mid-latitudes, between 30° and 60° north and south, winds that blow toward the poles are turned toward the east by the Coriolis effect. Because they blow from the west to the east, they are called prevailing westerlies. The prevailing westerlies blow generally from the southwest in north latitudes and from the northwest in south latitudes. The prevailing westerlies play an important part in the weather of the United States.

FIGURE 11
Global Winds

A series of wind belts circles Earth. Between the wind belts are calm areas where air is rising or falling. **Interpreting Diagrams** *Which global wind belt would a sailor choose to sail from eastern Canada to Europe?*

Go Online **active art**
For: Global Winds activity
Visit: PHSchool.com
Web Code: cfp-4023



Go Online **active art**
For: Global Winds activity
Visit: PHSchool.com
Web Code: cfp-4023

Students can interact with the art about global winds online.

Lab zone **Teacher Demo** L2

Observing Global Wind Belts

Materials globe

Time 5 minutes

Focus Remind students that the major wind belts are trade winds, prevailing westerlies, and polar easterlies.

Teach Spin the globe in a counterclockwise direction (west to east) while moving your finger over the Northern Hemisphere from north to south. Ask: **How does this path model global trade winds?** *(The path of global winds in the Northern Hemisphere curves to the right in the same way.)* Point out where the jet streams flow, using Figure 12 as a guide. Ask: **Why do you think the jet stream is farther south in the winter?** *(As the sun's direct rays move south, the global wind belts also shift south.)*

Apply Have students use the globe to locate a city that interests them. Ask: **Which major wind belt flows over that location?** *(Answers will vary, depending on the locations students choose.)* Suggest that students find the latitude of their location to determine which global wind belt flows over it. **learning modality: visual**

All in One **Teaching Resources**

- Transparency I17

Differentiated Instruction

Special Needs L1

Modeling Wind Hold a pinwheel over a lamp with an incandescent light bulb turned off. The pinwheel will remain stationary. Then hold the pinwheel over the lamp with the light bulb turned on. When the lamp gets hot, the pinwheel will start to spin. Ask: **Why did the pinwheel start spinning after the light bulb was turned on?** *(The hot light bulb heated the air around it, which rose and turned the pinwheel.)* **learning modality: visual**

Monitor Progress L2

Oral Presentation Call on students to explain in their own words the similarities and differences between the prevailing westerlies and the trade winds.

Answers

Figure 10 Global winds still affect a ship's speed. However, they are not as important as in the past because modern ships are equipped with engines.

Figure 11 Prevailing westerlies

Monitor Progress L2

Answer

Reading Checkpoint High-altitude bands of high-speed winds

Assess

Reviewing Key Concepts

1. a. The horizontal movement of air from an area of higher pressure to an area of lower pressure **b.** Wind is the movement of air from an area of higher pressure to an area of lower pressure. Differences in air pressure are often caused by differences in air temperature. **c.** Wind blowing over skin removes body heat, so the wind would cause a person's body to feel colder than it would if there were no wind.

2. a. Winds that blow over short distances **b.** Unequal heating of Earth's surface within a small, local area **c.** A sea breeze occurs during the day when the sun heats up the land faster than it does nearby bodies of water. A land breeze occurs at night when air over the land cools more quickly than air over water.

3. a. Trade winds, prevailing westerlies, and polar easterlies **b.** Winds in the Northern Hemisphere between 30° north latitude and the equator blow generally from the northeast. In the Southern Hemisphere between 30° south latitude and the equator, the winds blow from the southeast. These steady easterly winds are called the trade winds. The prevailing westerlies blow generally from the southwest between 30° and 60° north latitudes and from the northwest between 30° and 60° south latitudes. Cold air near the poles sinks and flows back toward lower latitudes. The Coriolis effect shifts these polar winds to the west, producing winds called the polar easterlies. **c.** In the Northern Hemisphere, the Coriolis effect causes the trade winds to curve to the right as they move toward the equator. In the Southern Hemisphere, the trade winds curve to the left as they approach the equator.

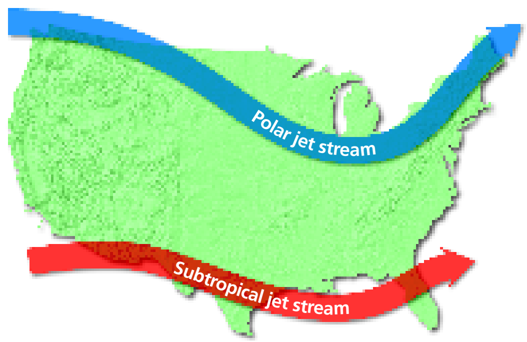
Reteach L1

As a class, make a chart comparing and contrasting local winds with global winds. Give examples of each and how they are formed.

All in One Teaching Resources

- Section Summary: *Winds*
- Review and Reinforce: *Winds*
- Enrich: *Winds*

FIGURE 12
Jet Streams
The jet streams are high-speed bands of winds occurring at the top of the troposphere. By traveling east in a jet stream, pilots can save time and fuel.



Polar Easterlies Cold air near the poles sinks and flows back toward lower latitudes. The Coriolis effect shifts these polar winds to the west, producing the polar easterlies. The polar easterlies meet the prevailing westerlies at about 60° north and 60° south latitudes, along a region called the polar front. The mixing of warm and cold air along the polar front has a major effect on weather in the United States.

Jet Streams About 10 kilometers above Earth's surface are bands of high-speed winds called **jet streams.** These winds are hundreds of kilometers wide but only a few kilometers deep. Jet streams generally blow from west to east at speeds of 200 to 400 kilometers per hour, as shown in Figure 12. As jet streams travel around Earth, they wander north and south along a wavy path.

Reading Checkpoint **What are the jet streams?**

Section 3 Assessment

Target Reading Skill
Relating Cause and Effect Refer to your graphic organizer about the effects of unequal heating to help you answer Question 1 below.

Reviewing Key Concepts

1. a. **Defining** What is wind?
   b. **Relating Cause and Effect** How is wind related to air temperature and air pressure?
   c. **Applying Concepts** It's fairly warm but windy outside. Use the concept of wind-chill factor to explain why it may be a good idea to wear a jacket.
2. a. **Defining** What are local winds?
   b. **Summarizing** What causes local winds?
   c. **Comparing and Contrasting** Compare the conditions that cause a sea breeze with those that cause a land breeze.
3. a. **Identifying** Name the three major global wind belts.
   b. **Describing** Briefly describe the three major global wind belts and where they are located.
   c. **Interpreting Diagrams** Use Figure 9 and Figure 11 to describe how the Coriolis effect influences the direction of the trade winds in the Northern Hemisphere. Does it have the same effect in the Southern Hemisphere? Explain.

Writing in Science

Explanation Imagine that you are a hot-air balloonist. You want to fly your balloon across the continental United States. To achieve the fastest time, would it make more sense to fly east-to-west or west-to-east? Explain how the prevailing winds influenced your decision.

Lab zone Chapter Project

Keep Students on Track Check to see that students are close to finishing the construction of their instruments. Encourage students to begin testing the instruments. Determine whether students have the basic instruments needed for a weather station, such as an anemometer, a thermometer, and a barometer. Students will make an anemometer in the Technology Lab.

Writing in Science

Writing Mode Exposition

Scoring Rubric

4 Exceeds expectations by thoroughly explaining that the fastest time could be achieved by flying west-to-east in the westerlies

3 Meets expectations by correctly explaining the fastest route

2 Includes a partial explanation

1 Includes a mostly incomplete or inaccurate explanation

Lab zone Technology Lab
Tech & Design

Measuring the Wind

Problem

Can you design and build an anemometer to measure the wind?

Design Skills

evaluating the design, redesigning

Materials

- pen • round toothpick • masking tape
- 2 wooden coffee stirrers • meter stick
- corrugated cardboard sheet, 15 cm × 20 cm
- wind vane

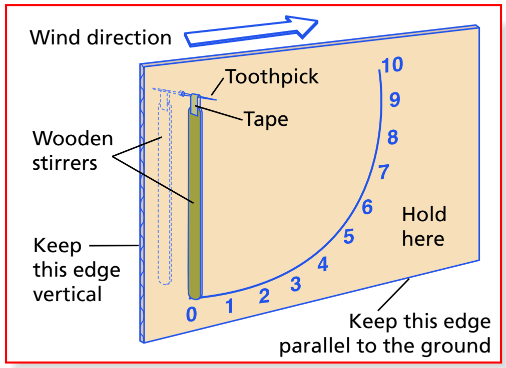
Procedure

1. Begin by making a simple anemometer that uses wooden coffee stirrers to indicate wind speed. On a piece of cardboard, draw a curved scale like the one shown in the diagram. Mark it in equal intervals from 0 to 10.
2. Carefully use the pen to make a small hole where the toothpick will go. Insert the toothpick through the hole.
3. Tape the wooden coffee stirrers to the toothpick as shown in the diagram, one on each side of the cardboard.
4. Copy the data table into your notebook.

Data Table

Location	Wind Direction	Wind Speed

5. Take your anemometer outside the school. Stand about 2–3 m away from the building and away from any corners or large plants.
6. Use the wind vane to find out what direction the wind is coming from. Hold your anemometer so that the card is straight, vertical, and parallel to the wind direction.



7. Observe the wooden stirrer on your anemometer for one minute. Record the highest wind speed that occurs during that time.
8. Repeat your measurements on all the other sides of the building. Record your data.

Analyze and Conclude

1. **Interpreting Data** Was the wind stronger on one side of the school than on the other sides? Explain your observations.
2. **Applying Concepts** Based on your data, which side of the building provides the best location for a door?
3. **Evaluating the Design** Do you think your anemometer accurately measured all of the winds you encountered? How could you improve its accuracy?
4. **Redesigning** What was the hardest part of using your anemometer? How could you change your design to make it more useful at very low or at very high wind speeds? Explain.
5. **Working With Design Constraints** How did having to use the materials provided by your teacher affect your anemometer? How would your design have changed if you could have used any materials you wanted to?

Communicate

Write a brochure describing the benefits of your anemometer. Make sure your brochure explains how the anemometer works and its potential uses.

Lab zone Technology Lab

Prepare for Inquiry

L2

Skills Objectives

Students will be able to
- build a prototype anemometer
- observe and measure wind direction
- design a wind vane or an improved anemometer
- interpret their data to determine which side of the school building is less windy than the other sides
- draw conclusions about any differences among class results

Prep Time 15 minutes
Class Time 40 minutes

Safety

Remind students to be careful when using the scissors. Do not do this lab on a day when there is danger of lightning or high winds. Review the safety guidelines in Appendix A.

All in One Teaching Resources
- *Lab Worksheet: Measuring the Wind*

Expected Outcome

Students will probably find that one side of the building had winds blowing at a lower speed than the other sides. If a west wind was blowing, then the east side of the building was probably the least windy.

Extend Inquiry

Communicate Students' brochures should explain each of the steps they went through in their design process and how these steps led to an improved design.

Analyze and Conclude

1. Students will probably find that the wind is stronger on one side of the building; the building blocked and slowed the wind on the other sides of the building.

2. The side that receives the least wind.

3. Answers will vary. Prompt students to explain why their wind measuring tool met or did not meet the goals.

4. Students may have had problems making a wind vane's indicator move freely enough to measure slight winds. Wind vanes or anemometers may not be sturdy enough to stand up in strong winds.

5. Students probably will want to modify their designs to use other materials, but most students will discover that easy-to-obtain materials perform satisfactorily.